the velocity distributions in these two classes may not depart widely from Maxwell's law, but that they are different from those in the spectral classes F, G, K and M.

Conclusions.—1. The radial velocities of the stars of classes B and A appear to decrease in general with increasing proper motion. There are, however, some inexplained anomalies.

2. The velocity distributions of classes B–B5 and A differ from the distributions found for the F, G, K and M classes by Kapteyn and Adams, appearing to be more clearly in accord with Maxwell's law.

3. The effects of the magnitude-velocity equation are clearly shown in the classification of the B and A stars made for this investigation.

4. There are some indications of a small abrupt change in the velocities of both classes in the smaller proper motions. There are also some indications in the classes F, G and K of such a change but in proper motions somewhat larger than in the early classes.

[1] *Astrophys. J.*, **41**, 318.
[2] These PROCEEDINGS, **1**, 14.

ASYMMETRY IN THE PROPER MOTIONS AND RADIAL VELOCITIES OF STARS OF CLASS B AND THEIR POSSIBLE RELATION TO A MOTION OF ROTATION

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Received by the Academy, April 8, 1916

In the course of other investigations asymmetry in the proper motions of the B stars was suspected. A preliminary investigation has shown a systematic difference between the proper motions in the region about 0^h and that opposite. The results of a comparison of the proper motions in these two regions and also with the regions within 40° of the apex and the antapex of solar motion are given in the table. The average radial velocities of the stars (V_2) are also included.

An examination of the individual values shows a marked consistency in all of the regions. These results depend upon Campbell's catalog of class B stars in *Lick Observatory Bulletin*, No. 196. As is well known these stars have a marked preference for the Milky Way.

The minima corresponding to the apices of the solar motion fall at $6\frac{1}{2}^h$ and 19^h. The two maxima corresponding to the parallactic motion of the Sun fall at 2^h and $13\frac{1}{2}^h$. These two points are almost exactly at right angles to the direction of the Sun's motion.

Region	*Apex*	*Antapex*	22^h–2^h	10^h–14^h	10^h–14^h[1]	10^h–14^h[2]
Magnitude	4.4	4.0	4.3	3.7	4.3	3.7
V_2 in km	7.8	6.2	6.8	5.9	7.1	6.0
Proper Motion	0″.014	0″.013	0″.020	0″.043	0″.038	0″.040
No. of stars	21	44	18	27	20	26

[1] Omitting all stars brighter than 3^M0 to make average magnitudes comparable with region at 22^h–2^h.

[2] Omitting the only apparently abnormal value of $\mu = 0''.119$.

A cursory examination of the right ascensions of Boss' *Preliminary General Catalogue* reveals a consistently smaller number of very small proper motions in the region 10^h to 14^h than in the region 22^h to 2^h. A preliminary examination of the A stars shows a similar (but smaller) effect if we omit the stars having proper motions of 0″.2 and over.

At the time of finding asymmetry in these proper motions the determination by Charlier of the motion of the node of the invariable plane of the solar system on the plane of the Milky Way was unknown to me. The value for the motion derived by Charlier and the preliminary value obtained by me from the B stars are as follows:

Charlier (Boss *P. G. C.*) + 0″.0035 per year,
Perrine (class B) + 0.012 per year.

If the observed phenomenon is in reality a relative motion of the invariable plane with respect to the *Milky Way as a whole* the angular motion as derived from different classes of stars, but especially from stars at widely different distances, should be exactly the same. The above discordances in the values throw doubt on the constancy of that angle.

Preliminary solutions for the apex and velocity of solar motion from northern and southern stars separately of class B and of 110 stars brighter than 3.0 magnitude of all spectral classes give systematically different results. The solar velocities derived in this way have a particular bearing on the above question and are given below.

	Northern Stars km.	*Southern Stars km.*
Class B, 3.0 and fainter	−17.0	−24.8
2.9 and brighter, all spectral classes	−14.4	−24.5

If there is no motion of rotation the values of the solar velocity derived from these different regions should be the same except for the effects of accidental variations whether the invariable plane is in motion or not. If however, the stellar system is rotating in a retrograde direction about the poles of the Milky Way, exactly such differences as the above should result.

It seems highly probable that the invariable plane may also be in motion.

Conclusions.—1. The stars of class B show systematic differences in the proper motions in the two regions of the Milky Way at right angles to the direction of solar motion.

2. The solar velocities derived from the B stars in the northern and southern hemispheres separately differ, that from the northern stars being the smaller.

3. These conditions appear to be best explained by a general motion of rotation of the system of stars in a retrograde direction about an axis perpendicular to the Milky Way.

The details of these preliminary investigations will be published elsewhere.

THEORY OF AN AEROPLANE ENCOUNTERING GUSTS

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Received by the Academy, April 10, 1916

A number of references to the theory of the stability of aeroplanes may be given,[1] but on their behavior in gusts little has been printed,[2] though much is probably known and held secret by foreign governments. Last summer I was asked to develop a theory of the effect of gusts upon (symmetric) aeroplanes, in particular upon a definite machine of which the aerodynamical coefficients were furnished me by Mr. Hunsaker. Two questions were to be answered: First, what is the effect of a gust upon the longitudinal motion in the uncontrolled machine; second, what is the effect when the machine is so constrained by an automatic device as to maintain its axis horizontal? My report, submitted to our National Advisory Committee for Aeronautics, will appear as a part of the *Report of the National Advisory Committee for Aeronautics, 1915* (Senate Document No. 268, 64th Congress, 1st Session). By the courtesy of the Committee I am permitted to give here a brief account of this work.

In treating the motion of an aeroplane the machine is referred to a set of moving axes x, y, z fixed in the body, and directed backward, to the left, and upward in normal horizontal flight with velocity $-U$. Departures from this standard condition of flight are treated by the method of small oscillations. If $U + u$, v, w, p, q, r be the linear and angular velocities in the disturbed motion and if u_1, v_1, w_1, p_1, q_1, r_1 be the linear and rotational velocities of the gusts (taken with the proper sign), the aerodynamic forces acting upon the machine will vary from those acting in the standard conditions by amounts which may be determined by the eighteen aerodynamic constants X_u, X_w, X_q, Z_u, Z_w, Z_q, M_u, M_w, M_q,